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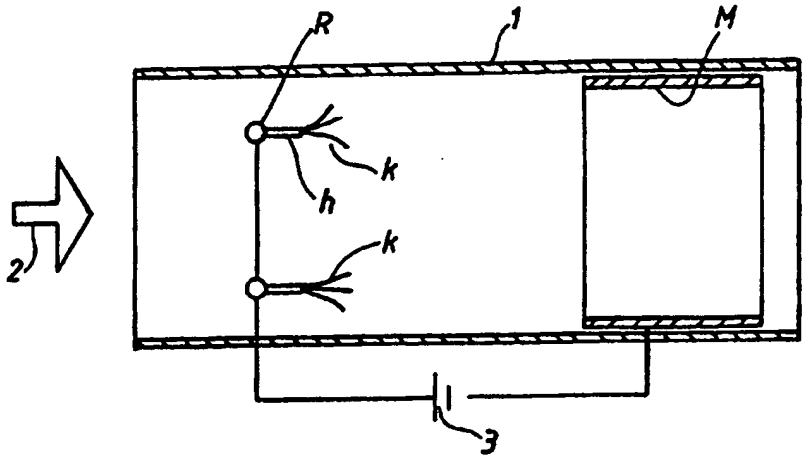

(57) Abstract

A device for transporting air, said device using an electric ion wind and including at least one corona electrode (K) and at least one target electrode (M) provided downstream of the corona electrode (K), seen in the desired direction of the air flow. A d.c. voltage source (3) has its positive terminal connected to the corona electrode (K) and the other terminal to the target electrode (M), the potential being such that an ion generating a corona discharge appears at the corona electrode and a transport of air is directed towards and through the target electrode (M). The corona electrode (K) includes at least one and preferably several wire-shaped electrode elements (k) having their free ends directed towards the plane of the target electrode (M). The corona discharge is stable, i.e. without risk for so-called streamers effect. This is achieved by the corona element or more correctly its free end directed towards the target electrode (M) consisting of a sufficiently thin wire-shaped element having an equivalent diameter less than 0.2 mm and preferably less than 0.1 mm.

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Case W 629

Device for transporting and/or cleaning air by corona discharge

The present invention relates to a device for transporting air with the aid of so called ion-wind or corona-wind, the device being of the kind set forth in the preamble of claim 1.

It is previously known that an air transport in principle can be achieved with the aid of a so-called electric ion-wind or corona-wind. Such a ion-wind is created when a corona electrode and a target electrode are arranged at a distance from each other, said electrodes being connected to respective terminals of a d.c. voltage source. The design of the corona electrode and the potential of the voltage source are such that a corona discharge appear at the corona electrode. This corona discharge produces air iones with the same polarity as the corona electrode and possibly also charged so-called aerosols, i.e. solid or liquid particles present in the air and becoming charged upon collision with the charged air ions. The air iones move rapidly, under the influence of the electric field, from the corona electrode to the target electrode, where they relinquish their electric charge and again return to neutral air molecules. During this movement the air iones are constantly in collision with the non-charged air molecules, whereby the electric forces are also transferred to the latter, which are thus drawn in direction from the corona electrode to the target electrode, thereby causing an air transport in the form of a so-called ion-wind or corona-wind.

Arrangements for transporting air based upon electric ion-wind are for instance described in DE-OS 2854716, DE-OS 2538959, GB-A-2112582, EP-A1-29421 and US 4 380 720. However, these suggesred prior art arrangements have been found extremely ineffective, and have not achieved any practical significance. Considerably improved, both effective as well as practically useful, air transporting devices based upon electric ion-wind are descibed in the patent portfolio of former Astra Vent, now TL Vent.

Common for all the devices mentioned above is that a corona electrode and a target electrode are arranged at a distance from each other in the direction of the desired air stream, said corona electrode as well as said target electrode having such a design that they allow a through-going air flow. The target electrode is located downstream of the corona electrode in the desired direction of flow and a d.c. voltage source is connected between the corona electrode and the target electrode, the potential of said d.c. voltage source and the design of the corona electrode being such that a corona discharge appear at the corona electrode, said discharge initiating air iones.

In all the previous known devices the electric electrodes are arranged inside an air flow duct that surrounds said electrodes. However, as can be learnt from the above-mentioned applications in the name of TL Vent such ducts are not absolute necessary if the device is designed in accordance with what is described in said international applications.

The presently presented corona electrodes for air transporting devices of this kind can be divided into two main groups, i.e. on one hand longitudinal, essentially wire shaped corona electrode elements that extend across the air flow path and on the other hand pointed corona elements, e.g. in the shape of thin wires or needles, that are arranged axially in the air flow path having one end connected to a holder and the other free or pointed end directed towards the target electrode.

The requirements called for, as regards the corona electrode in an air transporting device of the present type, are that the corona discharge initiated at the corona electrode should give rise to as large air transport as possible, and further the corona discharge should be stable and initiate as small generation as possible of toxic gases, primarily ozone and nitrogen oxides. It is also important that the air flow through the device is as even as possible, especially if the the device is intended also for air cleaning.

Experimentally it has been shown that essentially improved air transport is achieved with the aid of pointed or wire-shaped corona electrode in comparison to longitudinal corona

electrode. The pointed or wire-shaped corona electrode is arranged, as described above, axially in the centre of the air flow path with the free end directed towards the target electrode. However, this problem solution gives rise to other very serious problems. If such a pointed corona electrode uses positive corona discharge, said corona discharge gets unstable by the creation of elongated, wire-shaped corona discharge ducts, so-called streamers, in the surrounding air.

As a consequence of this a positive corona discharge from such a pointed corona electrode can not be used in tedious operations. If such a pointed corona electrode instead uses a negative corona discharge, said problems do not occur in a similar way but on the other hand negative corona discharge generates many times greater volumes of toxic gases, e.g. ozone and nitrogen oxides. Therefore, negative corona discharge is not suitable because of the requirements for devices of the present type.

The aim of the present invention is to provide an air transporting device of the above-mentioned type having a corona electrode with a design that better fulfills the above-mentioned requirements than the previous proposed designs of the corona electrode.

The invention is based on the finding that a positive corona discharge from a pointed or wire-shaped corona electrode having its free end directed towards the target electrode is stable in operation if the corona electrode is sufficiently thin closest to its free end.

According to the present invention the above-mentioned requirements upon the corona electrode of an air transporting device of the present type are fulfilled in that the corona electrode includes at least one, preferably several, essentially wire-shaped corona electrodes, the free end of the element (k) being of as thin material as possible with regard to mechanical stability.

Experimentally it has been shown that conductive or semi-conductive material thinner than 0.2 mm and preferably thinner than 0.10 mm is suitable for the purpose. In contrast to previously known solutions, e.g. according to what is disclosed in SE patent application 8506067-1, where the corona electrode

is arranged axially in the centre of the air flow, the corona electrode according to the present invention can include a number of corona electrode elements consisting of several wire-shaped elements located in a common holder, said wire-shaped elements preferably being distributed across the cross-section of the air flow duct.

Surprisingly it has shown that these small corona electrode elements, even if several of said elements are located with one end in a common holder and the other end directed reasonably free in the main direction of the air flow, however primarily within an imaginary cone with a crest angle not increasing 180°, do not have any significant screening effects between themselves. This indicates that some or someone of these elements within the same group to a substantially larger degree than other elements within the group supplies the air with an essentially larger number of air iones.

The surprising observation that the ion clouds around a group of corona elements of the device according to the present invention to a substantial degree is created by all or at least most of the elements within the group, this being a difference compared to the function of all previously known corona electrodes, also means that the risk for unstability, i.e. the creation of streamers, is reduced since the strain per element of the corona currency is reduced in proportion to the number of elements.

The explanation to stable positive corona discharge from a corona electrode according to the invention is probably to be found in the fact that in connection with a sufficient thin wire element the difference in field strength at the envelope surface closest its absolute end and the field strength at its absolute end is equilibrated.

It is of course also technically possible, however impractical, that the corona electrode element designed in accordance with the present invention is terminated by a point. However, such a design is not improving the device. From a practical point of view there is of no importance whether the absolute end of the electrode, i.e. the visible, cut-off cross-sectional surface is primarily circular, oval or of another type. Further, it is of no importance whether the wire itself

has a different cross-section than cylindrical. Therefore, a thin wire-shaped corona electrode element characterized by a diameter according to the invention should be interpreted as a circular, symmetrical cross-section corresponding to a surface of a different cross-section of a blank for the corona electrode. Experimentally it has also turned out that the corona electrode element (k), unlike previously known ion-wind devices, preferably can be located relatively arbitrary in the cross-section of the air flow. This means that different corona elements in many practical applications are at a distance from the target electrode that varies quite a lot.

The corona electrode according to the invention can consist of or be coated with both conductive or semi-conductive material, e.g. tungsten, stainless material, platina, gold, carbon fiber or other materials.

Notwithstanding its dimensions it is of course preferable if the wire is mechanically stable. Therefore, a resilient material for the wire is preferable.

The characterizing features of the invention are described in the appending claims.

Below the invention will be described more in detail, reference being made to the accompanying drawing where Figs.1 and 2 schematically illustrate different embodiments of an air flow transporting device according to the invention.

Fig.1 schematically illustrates a first embodiment of an air transporting device according to the invention, said device including an air flow duct 1, the desired air flow direction being marked by an arrow 2. In the duct 1 a corona electrode K and a target electrode M are provided. The corona electrode K and the taget electrode M are connected to respective terminals of a d.c. voltage source 3.

In the disclosed embodiment the air flow duct 1 is presumed to be tube-shaped with a circular or similar cross-section. The target electrode M is designed as a cylinder with a shape corresponding to the air flow duct 1. In the disclosed embodiment the target electrode M is arranged closely adjacent to the wall of the air flow duct 1 or directly upon its inner wall as a conductive layer. The device functions in such a way that a corona discharge appears at the corona electrode K and produces

air iones that under influence from the electrical field migrate from the corona electrode K to the target electrode M and thereby initiate the desired air flow 2 trough the duct 1.

According to the present invention the corona electrode K can include several corona elements k grouped in separate holders h, the corona elements k being in the shape of thin wires and each holder h receives several wires. These holders h are located in the device according to Fig. 1 around a ring R inside the air flow duct with the holder upstreams and the corona element downstreams, the free ends of the corona element k being directed towards the target electrode M.

Fig.2 schematically illustrates another embodiment of the device, the corona electrode K including several groups of corona elements k arranged upon a common holder H that in the shape of a rounded rod extends through the symmetrical axis of the duct, upstream of and at a distance from the target electrode M. The holder H is designed to rotate or turn around an axis that either coincide with the symmetry axis of the holder or is substantially parallel with said axis. Thereby the free ends of the electrode element k are accessible for cleaning from the inlet of the duct.

This can easily be arranged if a convenient brush or some kind of rake is arranged upstream of the holder at such a distance that in connection with the rotation of the holder the wire-shaped elements of the corona element k directly contact said brush/rake. Preferably, this device can also be a part of the so-called screening electrode.

In the disclosed embodiment the corona electrode K is connected to positive potential and the target electrode M is connected to negative potential relative to earth potential. In many applications it is however convenient to connect the target electrode M to earth potential or a potential close to earth.

In connection with Fig.1 the device is described as a tube-shaped air flow duct having a circular or similar cross-sectional area. However, the invention can also be used in connection with other possible shapes, e.g. a narrow rectangular shape according to Fig.2 or a slot-shaped cross-sectional area. In such cases a number of corona electrodes K

according to the present invention are provided at a distance from each other and in a plane arranged upstream of the plane of the target electrode M, seen in the direction of the air flow. Thereby, each such corona electrode K supplies the accompanying part of the total air flow duct with air ions.

Of course the device for cleaning of the corona electrode K can be adapted and designed in view of the design of the corona electrode K itself and the structure of other parts of the device according to the invention.

Above the device according to the invention has been described in detail only as regards the design of the corona electrode. As regards the remaining structure of the air transporting device reference is made to the patent portfolio of TL Vent showing previously known structures that can be improved to a considerable degree in view of the requirements for an ion wind device defined in the present application, i.e. by designing the corona electrode K as characterized in the present application. Thus an electrode can miss a surrounding duct with physical walls. Further a convenient screening upstream of the corona electrode is provided, to avoid an ion stream in direction upstream of the corona electrode, as described in said patent portfolio. Due to the essentially improved characteristics of the device according to the invention it is possible in many applications to use only one polarity of the d.c. voltage source. In connection therewith it is suitable that the target electrode M is earthed and the corona electrode K is connected to positive voltage.

An electric earthed target electrode M can also be in the shape of a convector for heat/cold. Further the respective groups of corona electrode elements can be connected to the positive terminal of the d.c. voltage source via high-resistive electrical components, thus rendering the device safe at touch.

Claims

1. Device for transporting air, said device using an electric ion wind and including at least one corona electrode (K), at least one target electrode (M) axially spaced from and downstream of the corona electrode (K), seen in direction of the air flow, said target electrode (M) allowing the air flow to pass through, and a d.c. voltage source (3) having its positive terminal connected to the corona electrode (K) and the other terminal to the target electrode (M), the design of the corona electrode (K) and the positive potential between the electrodes being such that an ion generating discharge appears at the corona electrode, **characterized in** that the corona electrode includes at least one wire-shaped corona element (k) having one end provided in a holder (h) and the free end pointing in a direction having one vector component that is perpendicular to the plane of the target electrode, the equivalent diameter of the element (k) being less than 0.2 mm and preferably less than 0.1 mm.

2. Device according to claim 1, **characterized in** that the corona electrode (K) includes several electrode elements (k).

3. Device according to claim 2, **characterized in** that several electrode elements (k) are assembled in the same holder (h), said corona electrode (K) includes at least one such assembly of electrode elements (k).

4. Device according to claim 3, **characterized in** that the corona electrode is turnable around a suitable axis in such a way that in doing so the corona element frictionally contacts a suitable cleaning device arranged upstream of the corona electrode.

5. Device according to claim 4, **characterized in** that the cleaning device constitutes a part of the so-called screening electrode (S).

6. Device according to claim 1-5, **characterized in** that the corona electrode element (k) is made of resilient material.

7. Device according to claim 1-6, **characterized in** that the corona element (k) is made out of or coated with gold or platina.

8. Device according to claim 1-6, **characterized in** that the target electrode is in the shape of a convector for heat-cold.

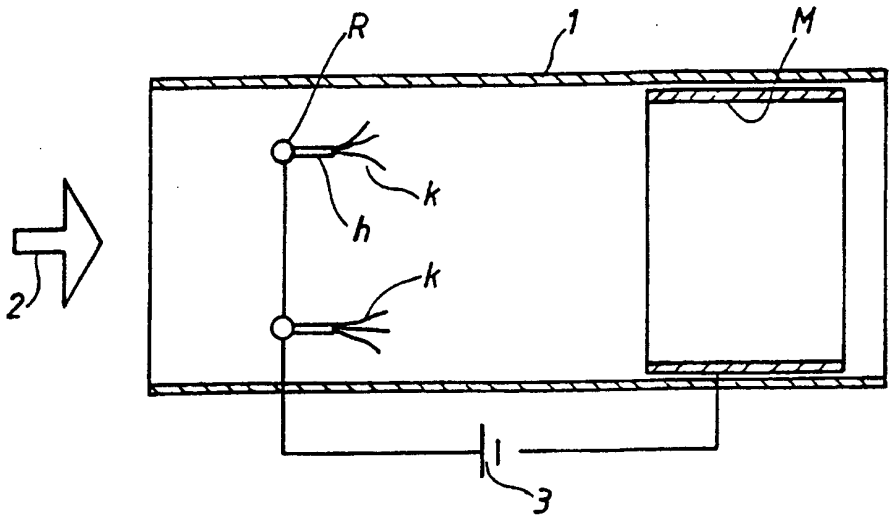

Fig.1

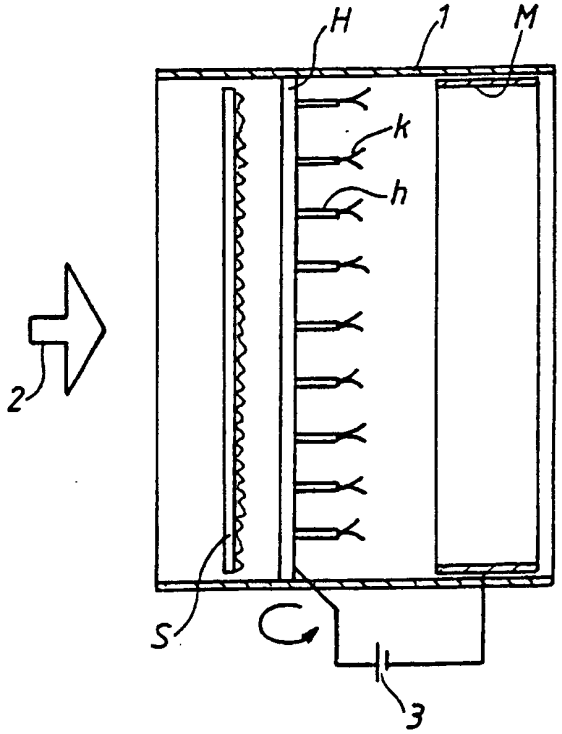

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 95/00906

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H01T 23/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H01T

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 8704020 A1 (ASTRAVENT AB), 2 July 1987 (02.07.87), figure 1, abstract ---	1-8
A	WO 8805972 A1 (ASTRAVENT AB), 11 August 1988 (11.08.88), figure 1, abstract ---	1-8
A	EP 0208169 A1 (ELTEX-ELEKTROSTATIK GESELLSCHAFT MBH), 14 January 1987 (14.01.87), figure 1, abstract --- --------	1-8

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
6 December 1995	08.12.95
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Rune Bengtsson Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

30/10/95

International application No.
PCT/SE 95/00906

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A1- 8704020	02/07/87	AU-B,B- 585428	15/06/89
		AU-A- 6831487	15/07/87
		EP-A,B- 0277953	17/08/88
		JP-T- 63501991	04/08/88
		SE-B,C- 453783	29/02/88
		SE-A- 8506067	21/06/87
		SU-A- 1796080	15/02/93
		US-A- 5006761	09/04/91
WO-A1- 8805972	11/08/88	AU-A- 1295788	24/08/88
		DE-A- 3866873	23/01/92
		EP-A,B- 0343184	29/11/89
		JP-T- 2502142	12/07/90
		SE-C- 456204	19/01/89
		SE-B- 8456204	12/09/88
		US-A- 5077500	31/12/91
EP-A1- 0208169	14/01/87	SE-T3- 0208169	
		DE-C- 3522881	02/10/86
		JP-A- 62002484	08/01/87
		SU-A,A- 1487827	15/06/89

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